Lysine Requirement of Cockatiel Chicks

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INTRODUCTION

Lysine may be the single most important amino acid that affects the protein nutrition of captive birds fed practical diets. It is the essential amino acid most often limiting in cereals and other seeds which comprise the main sources of nutrition for many caged birds. A deficiency of lysine in the diet of young domestic birds such as chickens, quail and turkeys results in poor growth and in failure to deposit the normal dark melanin pigments of feathers. Because body size and feather color are important considerations when assessing the value of caged birds, lysine nutrition had a high priority among problems that needed study.

This project was designed to determine the quantitative lysine requirement of young cockatiel chicks, based primarily on growth. Feather pigmentation was also studied. The basic approach was to feed newly hatched chicks diets in which the amino acids were provided by mixtures of pure amino acids in place of protein. The lysine content of the diet could thus be varied from low to high levels and the effects on growth and feathering determined.

MATERIALS AND METHODS

The management techniques used here were virtually identical with those we developed and presented in our final report of June 1983 to the AFA Research Committee: "Solid Food Requirements and Water Tolerance of Cockatiel Chicks from Hatching to Five Weeks." The basal diet, presented in Tables 1, 2, and 3, did not include lysine, which became the single variable in two feeding trials with groups of cockatiel chicks.

The levels of L-lysine added to the dry basal diet varied from 0.1% to 2.0%. Each group of 12-17 chicks was fed its diet from hatching to 14 days of age or longer. One of these experiments was concluded at 14 days, but then the chicks were fed either the same diets or were shifted to alternatives in order to observe recovery or, in the case of one group, the effects of imposing a deficiency half way through the growth period. Each bird was weighed each day before the first feeding at 6 a.m. Mortalities were recorded. Observations of feather pigmentation of all chicks were made from the time juvenile feathers could first be seen through the skin at 10 days until the experiments were concluded at fledging.

RESULTS

In the first experiment, the groups were fed the four levels of lysine to 14 days, at which time the results of feeding the diets were clear. The lowest level of lysine (0.1%) permitted only poor growth and survival, but 0.4% permitted much better growth and good survival, as shown in the growth data of figure 1 and table 4. The groups fed 1.0% or 2.0% lysine survived and grew well but not as rapidly as similar chicks fed 20% protein from isolated soybean protein supplemented with methionine, as presented in the report of our first study.

After 14 days, when the group fed 2.0% lysine was shifted to the diet containing 0.4% lysine, growth continued at approximately the same rate for 8 days, essentially in the same pattern as the group fed 1.0% lysine for the whole period. Meanwhile the group that was shifted from 0.4% lysine to the 20%

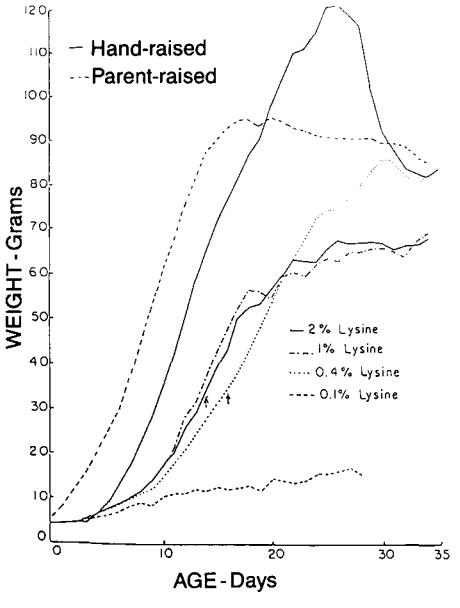

Figure 1. Growth curves of cockatiel chicks fed various levels of lysine in experiment 1. Chicks fed 0.4% lysine from hatching were switched to a 20% protein diet at 16 days of age. Chicks fed 2% lysine were switched to 0.4% lysine at 14 days of age.

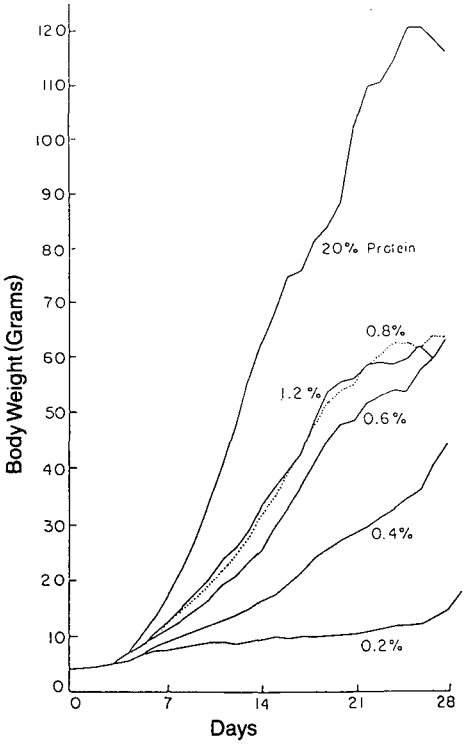

Figure 2. Growth curves of cockatiel chicks fed various levels of lysine in experiment 2.

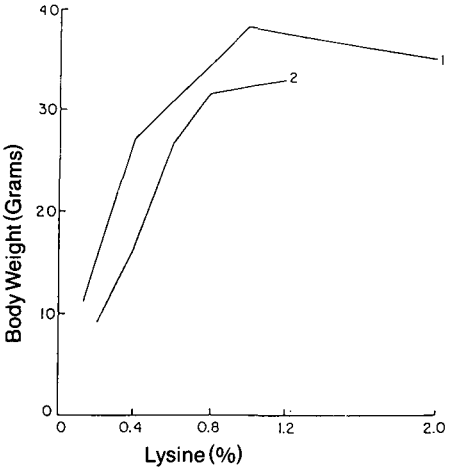

Figure 3. Growth response curves for experiments 1 and 2 based on body weights at 14 days of age.

protein diet grew rapidly and continued to gain up to the weight expected by fledging (80-90 grams).

The levels of lysine that had been chosen for the second experiment were based on the results of the first study. The lowest level (0.2%) permitted only slow growth (table 5 and figure 2), but was better than 0.1% lysine in experiment 1. Survival was also better with 0.2% lysine (table 5). Groups fed higher levels grew faster until the level of 0.8% lysine was reached and when maximum growth was obtained. As in the first experiment, body weight at 14 days of age was used as the criterion for determining the lysine requirement, as shown in Figure 3.

None of the groups fed the amino acid-containing diets grew as well as those fed the protein-based diet. No observable differences accounted for this effect.

With regard to feather pigmentation, no white or light feathers or parts of feathers were observed in areas that are normally dark. These observations were made in birds in which growth was responding to wide variations in the lysine concentrations of the diets.

TABLE 1

Lysine Diets

Ingredient	g/Kg
Soybean Oil	37.5
Cellulose	50.0
$CaCO_3$	10.0
$CaHPO_4 \cdot 2H_2O$	30.0
Vitamin Mix[1]	1.25
Mineral Mix[2]	12.3
Choline Chloride (60%)	4.2
Amino Acid Mix[3]	239.0
Corn Starch	458.35
Instant Clear Jel[4]	130.0
Na_2CO_3	15.0
NaCl	0.4
Total	988.0

1. Grau and Roudybush 1985
2. See Table 2 for mineral mixture.
3. See Table 3 for amino acid mixture.
4. Instant Clear Jel-Food Starch-Modified. National Starch and Chemical Co., Bridgewater, NJ 08807.

DISCUSSION

Until the experiments reported here were performed no data were available on the qualitative or quantitative requirements of cockatiels or other altricial birds for any amino acid. The results obtained with respect to growth effects are similar to those obtained with poultry and rats, with cockatiels apparently unable to synthesize lysine and thus completely dependent on the diet to supply it. After feeding several dietary levels to groups of cockatiels and noting the minimum concentration in the diet that permitted maximum growth, it was concluded that cockatiel

Experiment 1

	Lysine (%)			
	0.1	0.4	1.0	2.0
Basal	978.0g	978.0g	978.0g	978.0g
Lysine HCl	1.1	4.4	11.0	22.0
Starch	20.9	17.6	11.0	0.0
	1000.0g	1000.0g	1000.0g	1000.0g

Experiment 2

	Lysine (%)				
	0.2	0.4	0.6	0.8	1.2
Basal	988.0g	988.0g	988.0g	988.0g	988.0g
Lysine HCl	2.0	4.0	6.0	8.0	12.0
Starch	10.0	8.0	6.0	4.0	0.0
	1000.0g	1000.0g	1000.0g	1000.0g	1000.0g

chicks require 0.8% lysine in the solids portion of the diet when that diet contains approximately 20% protein. This fairly high requirement is not easily met by seeds alone, thus lysine is a nutrient that is marginal in many diets for breeding cockatiels that are feeding chicks.

The lack of effect of lysine deficiency on feather pigmentation is in marked contrast to that documented in turkeys, chickens and quail, in all of which lysine deficiency results in formation of feathers that lack melanin pigment. In those birds, abnormal white feathers are a diagnostic sign of lysine deficiency. When we began the lysine study we fully expected to see some effect of lysine deficiency in feathers, so the lack of effect was indeed surprising. Because so many different dietary levels of lysine were fed and such wide differences in growth were obtained, we believe it unlikely that any other level would have resulted in white feathers. At the lowest lysine level, mortality was high and feather growth of survivors was poor, but at moderate levels while growth was slow feathers did develop, and all appeared to have normal pigment.

The growth obtained with the amino acid based diet was less than that when soybean protein was fed, but this is not different from observations with other young birds. In order to achieve good growth in chicks, careful balancing by trial and error of the various amino acids was required, and even then the intact protein produced better growth.

SUMMARY

The lysine requirement of cockatiel chicks that were hand-fed from hatching was found to be 0.8% of the dry portion of the diet. This diet, which contained amino acids equivalent to 20% crude protein, was fed at 7% solids for 3 days, then 30% solids to weaning. Poor growth and survival was obtained with low levels of lysine, but feather pigmentation was normal at all lysine levels, and thus the effects of lysine deficiency on the melanin formation in cockatiels appear to differ strikingly from turkeys, quail, and chickens. It is concluded that satisfying the lysine requirement of young cockatiel chicks may be difficult with breeding diets based primarily on seeds.

REFERENCES

1. Grau, C.R. and T.E. Roudybush. 1985. Protein requirement of growing cockatiels. Proc. 34th Western Poultry Disease Conference, Davis, CA, March 4-6, 1985 in press.
2. Roudybush, T.E. and C.R. Grau. 1983. Solids in diets for hand raising cockatiels. Proc. 32nd Western Poultry Disease Conference, Davis, CA. Feb. 8-10, 1983, pp. 94-95. ●

TABLE 2

Mineral Mixture

Ingredient	mg/Kg diet
Manganese sulfate $MnSO_4 \cdot H_2O$	297.00
Cupric sulfate $CuSO_4 \cdot 5H_2O$	97.00
Colbaltous acetate $Co(C_2H_3O_2) \cdot 4H_2O$	20.00
Potassium iodate KIO_3	9.00
Magnesium carbonate $MgCO_3$	2752.70
Dibasic potassium phosphate K_2HPO_4	4950.00
Sodium molybdate $Na_2MoO_4 \cdot 2H_2O$	9.00
Sodium selenite $NaSeO_3 \cdot 5H_2O$	0.66
Zinc acetate $Zn(C_2H_3O_2)_2$	323.70
Ferrous sulfate $FeSO_4 \cdot 7H_2O$	644.00
Total	12,271.06

TABLE 3

Amino Acid Mix

Ingredient	g/Kg diet
L-Arginine[1]	11
Glycine	6
L-Serine	3
L-Histidine[1]	5
L-Leucine	11
L-Methionine	5
L-Cystine	3
L-Phenylalanine	6
L-Threonine	7
L-Tryptophan	2
L-Valine	8
L-Glutamic acid	127
L-Alanine	11
L-Aspartic acid	11
L-Proline	11
L-Isoleucine	7
L-Tyrosine	5
Total	239

1. Supplied as the hydrochloride in experiment 1, but as the free base in experiment 2.

TABLE 4
Experiment 1

Growth of cockatiels fed various levels of lysine from hatching to 14 days.

Lysine (%)	Age (Days) 1	4	7	14	4-14
	Number		Mean Body weights (g)		Survival (%)
0.1	12	12	8.46 NS*	11.61^{a}**	17
0.4	13	12	9.88	27.70^{b}	100
1.0	13	12	9.87	36.28^{c}	100
2.0	13	10	10.57	35.71^{c}	100

* At 7 days no significant differences exist among groups at $P<.01$ by a one-way analysis of variance.
** At 14 days groups not followed bythe same letter differ at $P<.01$. Significance was determined by a one-way analysis of variance followed by a Duncan's Multiple Range Test.

TABLE 5
Experiment 2

Growth of cockatiels fed various levels of lysine from hatching to 28 days.

Lysine (%)	Age (Days) 1	4	7	14	21	28	4-28
	Number		Mean Body weights (g)				Survival (%)
0.2	17	15	7.38^{a}*	9.13^{a}	10.17^{a}	14.32^{a}	20
0.4	17	17	8.91^{b}	16.30^{b}	28.18^{b}	44.02^{b}	59
0.6	16	14	10.99^{bc}	26.53^{c}	48.39^{c}	61.55^{c}	64
0.8	16	14	12.00^{cd}	31.55^{d}	55.60^{d}	63.20^{c}	79
1.2	16	15	12.41^{d}	32.89$_{d}$	54.78$_{d}$	62.93$_{c}$	73

* Body weights in the same column not followed by the same letter are significantly different at $P<.01$. Significance was determined by a one-way analysis of variance followed by a Duncan's Multiple Range Test.

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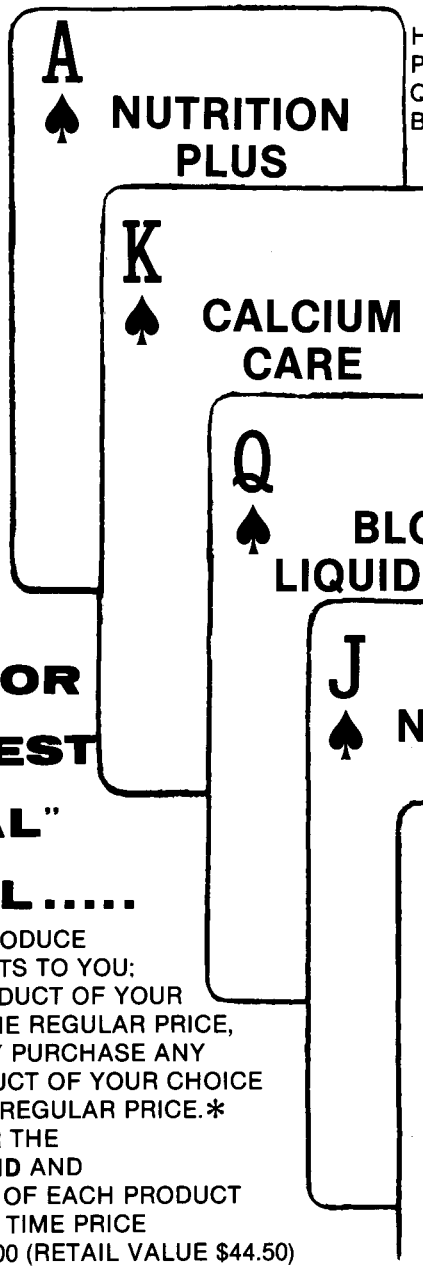

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